

R E M A R K S

Kindly enter and consider Claims 1 and 9 in the wording set forth in Appendix II of this paper. As indicated in the marked-up version of those claims which is set forth in Appendix I, the Claim 1 has been amended to read on the subject matter of Claim 8 (*Claim 8 is being canceled by applicants' amendment*), and applicants have corrected the wording of Claim 9. In the previous amendment, applicants amended Claim 9 by deleting the indefinite article before "*distillation column*" and inadvertently omitted the introduction of the substitute definite article (*corresponding to the change in the first line of Claim 8, page 3, of applicants' amendment dated February 26, 2001*).

Entry and consideration of the foregoing foregoing and the attached is deemed equitable since the changes in no instance alter the subject matter of the claims in a manner which introduces new matter or which would necessitate further consideration and/or search. Also, the amendment herewith presented is believed to clearly place the application in condition for allowance for the following reasons.

In the purification of ethylene oxide from an aqueous solution thereof which comprises formaldehyde, it is the separation of ethylene oxide and formaldehyde which poses a particular problem because both ethylene oxide and formaldehyde are gaseous at room temperature, with the boiling point of ethylene oxide being at 12°C (53.6°F), the boiling point of acetaldehyde being at 20.2°C (68.4°F), and the boiling point of formaldehyde being at -19°C (-2.2°F) at normal pressure. Applicants' invention as well as the references applied by the Examiner in the rejection of applicants' claims under 35 U.S.C. §103(a) attempt to solve the problem of the separation of aldehydes and ethylene oxide.

The physical data referred to in the foregoing and in the following are disclosed in **Hawley's "Condensed Chemical Dictionary"** (11th Edition, Van Nostrand Reinhold, New York (1987)). Copies of the pertinent pages of **Hawley's** dictionary are appended to this paper for the Examiner's convenience.

The process disclosed by **Delannoy et al.** (US 4,966,657) makes use of the fact that an aqueous solution releases gaseous aldehydes at a temperature which is higher than the boiling point of the pure alde-

hyde. For example, the flash point of a 37% formaldehyde solution in water is at a temperature of 85°C (185°F) which means that at 85°C the vapor phase above the solution comprises about 7% of gaseous formaldehyde (*explosive limits of air/formaldehyde mixtures: 7% to 73%*). By maintaining the bottom temperature of the distillation column suitably low and applying pressure (*ie. col. 3, indicated lines 35 to 41, and Example 1: 63°C = 145.5°F at a pressure of 5.6 bar, ie. col. 5, indicated line 39, of US 4,966,657*) the process of **Delannoy et al.** reduces the formation of gaseous aldehydes, and thereby reduces the amount of aldehydes which contaminate the top fraction of ethylene oxide which is recovered from the distillation. By maintaining a suitably low bottom temperature of the distillation column, however, a considerable amount of ethylene oxide is retained in the bottom fraction.

In the process disclosed by **Delannoy et al.**, the amount of ethylene oxide which is retained in the bottom fraction as well as the amount of aldehydes which are released from the bottom fraction and -ultimately- contribute to the contamination the top fraction of ethylene oxide are controlled by the temperature/pressure conditions of the bottom fraction in a similar manner. An increase in the temperature and/or a decrease in the pressure provides for

- a decrease in the amount of ethylene oxide retained in the bottom fraction,

and, at the same time,

- an increase in the amount of gaseous aldehydes in the vapor phase and -correspondingly- an increase in the amount of aldehydes which contaminate the top fraction of ethylene oxide.

The teaching of **Delannoy et al.** that the bottom fraction of the distillation column contains ethylene oxide in amounts corresponding, on a weight basis, to 0.15 to 3 times the weight of water (*ie. col. 2, indicated lines 5 to 18, of US 4,966,657*) is therefore crucial with regard to the temperature/pressure conditions and the ultimate contamination of the ethylene oxide top fraction by aldehydes.

It is, of course, preferable that the ethylene oxide content in the bottom fraction is of a limited percentage (*ie. col. 2, indicated line 63, to col. 3, indicated line 2, of US 4,966,657*). However, that fact that **Delannoy et al.** specifically disclose an ethylene oxide content in the bottom fraction at a minimum amount of 0.15 times the weight of water indicates that a reduction of the ethylene oxide content below 0.15 times the weight of water requires temperature/pressure

conditions in which gaseous aldehydes are generated to a degree which is beyond the amount acceptable as a contamination of the ethylene oxide fraction recovered over the top of the distillation column.

In this context, it is respectfully noted that the statement of *Delannoy et al.* in col. 3, indicated lines 3 to 7, of **US 4,966,657** which is addressed by the Examiner relates to the feed -ie. the contaminated ethylene oxide which is introduced into the distillation column (ie. indicated as the liquid stream 10 in Figure 1 of *Delannoy et al.*) and not, as applied by the Examiner, to the bottom fraction of the distillation column. The respective statement is, therefore, of subsidiary pertinence where the composition of the bottom fraction (ie. 12 in Figure 1 of *Delannoy et al.*) is concerned.

In short, *Delannoy et al.* teach that it is possible to reduce the aldehyde contamination of ethylene oxide which is recovered as a top fraction of a distillation column by keeping the temperature of the bottom fraction -and hence the temperature of the distillation column- (or the temperature/pressure conditions) below a point where considerable amounts of gaseous aldehydes are generated. *Delannoy et al.* also teach that the respective advantage is bought at the expense of the amount of ethylene oxide which is recovered in purified form in view of the losses incurred in the high amounts of ethylene oxide which remain in the bottom fraction. In light of the foregoing it is immediately apparent to a person of ordinary skill in the art that the high amounts of ethylene oxide in the bottom fraction in accordance with the process of *Delannoy et al.* are critical in order to obtain the requisite purity of ethylene oxide in the top fraction of the distillation.

The Examiner has argued that the quality of the ethylene oxide which is recovered as the top fraction of the distillation as defined in applicants' Claims 1 and 2, as well as the degree of ethylene oxide depletion of the bottom fraction set forth in Claims 1 and 2, are no more than "desired results" which a person of ordinary skill would achieve by routine optimization of the process disclosed by *Delannoy et al.* However, in accordance with the principles which are applied in the process disclosed by *Delannoy et al.* a decrease of the amount of ethylene oxide in the bottom fraction results in an increase in the aldehyde content of the ethylene oxide fraction which is recovered over to top of the distillation column. It is, therefore, not immediately apparent to applicants how a mere optimization

of the process disclosed by **Delannoy et al.** can possibly result in a decreased amount of ethylene oxide in the bottom fraction and, at the same time, a decreased aldehyde contamination of the ethylene oxide fraction which is recovered over to top of the distillation column. The teaching of **Delannoy et al.** clearly fails to suggest or imply that any one of the process conditions can be modified in a manner which would provide for a decreased amount of ethylene oxide in the bottom fraction and, at the same time, a decreased aldehyde contamination of the ethylene oxide top fraction. The teaching of **Delannoy et al.**, when taken alone, therefore does not convey to a person of ordinary skill in the art the information which is needed to arrive at the features of applicants' invention or render applicants' invention *prima facie* obvious.

The Examiner has argued that a person of ordinary skill would have used the teaching of **Gilman et al.** (US 3,418,338) as a motivation to optimize the process of **Delannoy et al.** because **Gilman et al.** disclose the requisite amounts of ethylene oxide in the bottom fraction and of formaldehyde in the top fraction which are specified in applicants' Claims 1 and 2. It is believed to be immediately apparent from the foregoing that the motivation to improve on the requisite amounts in the process of **Delannoy et al.** alone is insufficient to arrive at the goal because, in light of the principles underlying the process of **Delannoy et al.**, it is not apparent how such an optimization can be realized. It is impermissible within the framework of Section 103 to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts which are necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art (ie. In re Wesslau, 353 F.2d 238, 241, 147 USPQ 391, 393 (CCPA 1965)).

It is also believed to be immediately apparent from the foregoing, that the principles which are applied to separate aldehydes from ethylene oxide in accordance with the process disclosed by **Gilman et al.** have to differ from the principles underlying the process disclosed by **Delannoy et al.**, particularly since the process of **Gilman et al.** provides for a bottom fraction of the distillation which is depleted of ethylene oxide and, at the same time, for a top fraction of ethylene oxide which has a reduced aldehyde content whereas such a result is apparently not achievable in accordance with the disclosure of **Delannoy et al.**

In the process disclosed by **Gilman et al.** the distillation column is operated at an overhead temperature of 103°C (217.4°F; ie. col. 4, indicated lines 10 and 11, of US 3,418,338), and the reduction of the aldehyde content in the ethylene oxide top fraction of the distillation can, therefore, not be due to the fact that the formation of gaseous aldehydes is prevented. In contrast to the teaching of **Delannoy et al.**, the process of **Gilman et al.** allows for the formation of significant amounts of gaseous aldehydes, and the gaseous aldehydes are removed from the vapor phase by means of water which is introduced near the top of the distillation column and which, by passing the column in countercurrent to the ethylene oxide vapor, extracts gaseous aldehydes from the vapor phase (ie. col. 2, indicated lines 60 to 64, of US 3,418,338). The only meaningful combination of the processes disclosed by **Delannoy et al.** and by **Gilman et al.** therefore provides that it is possible to further reduce the contamination of the ethylene oxide top fraction which is recovered in the process of **Delannoy et al.** by introducing water into the upper part of the distillation column. A simultaneous reduction of the ethylene oxide content of bottom fraction, however, entails an increased temperature and/or a decrease in pressure of the bottom fraction with the consequence that the process of **Delannoy et al.** is replaced by the process of **Gilman et al.**

The respective modification of the teaching of **Delannoy et al.** or the combination of the teaching of **Delannoy et al.** with the disclosure of **Gilman et al.** would not only change the principles underlying the process disclosed by **Delannoy et al.**, it would destroy those principles. Under such circumstances the Court has held that the teachings of the references are not sufficient to render a claimed invention *prima facie* obvious (ie. In re Ratti, 270 F.2d 810, 813, 123 USPQ 349, 352 (CCPA 1959)).

The same applies *mutatis mutandis* when the teaching of **Coffey** (US 5,529,667) is enlisted as an additional source for information which is pertinent with a view to solving the problem posed by the separation of ethylene oxide and aldehydes in the purification of aqueous methylene oxide / aldehyde mixtures.

Coffey discloses that the process taught by **Gilman et al.** fails to reduce the amount of aldehydic impurities in ethylene oxide to the extent necessary for economic purposes (ie. col. 2, indicated lines 12 to 18, in conjunction with col. 2, indicated lines 60 to 65, of US 5,529,667).

In order to obviate disadvantages of the conventional extractive distillation as, for example, disclosed by **Gilman et al.** and to reduce the amount of water which is needed in the conventional extractive distillation, **Coffey** makes a number of changes in the general set-up of the extractive distillation.

On the one hand, **Coffey** reduces the water consumption *inter alia* by reducing the portion of the distillation column which is used for the extractive distillation. In accordance with the teaching of **Coffey** the water for the countercurrent extraction of aldehydes is introduced above the point at which the raw aqueous ethylene oxide solution is fed in (ie. No. 32, Figures 1 to 3, of US 5,529,667) but in the lower part of the distillation column (ie. No. 62, Figures 1 to 3, of US 5,529,667) (note also the comments in col. 3, indicated lines 20 to 26, col. 6, indicated line 62, to col. 7, indicated line 12, and col. 10, indicated lines 62 to 67, of US 5,529,667). Aldehydes which are not removed in the extraction section remain in the vapor phase. Acetaldehyde vapor which passes through the extraction section is then removed by means of a side stream which is taken off at a point above the feed of the raw aqueous ethylene oxide solution and above the point at which the extraction water is fed to the column (ie. No. 83, Figures 1 to 3, of US 5,529,667) (note also the comments in col. 3, indicated lines 57 to 60, col. 8, indicated lines 15 to 35, and col. 11, indicated lines 1 to 4, of US 5,529,667). Formaldehyde vapor which passes through the extraction section is removed as a contaminated top fraction of the distillation (ie. Nos. 54 and 87, Figures 1 to 3, of US 5,529,667) (note also the comments in col. 3, indicated line 66, to col. 4, indicated line 8, col. 8, indicated line 61, to col. 9, indicated line 1, and col. 11, indicated lines 7 to 10, of US 5,529,667). Purified ethylene oxide is recovered as a side stream of the distillation column below the top of the distillation column (ie. No. 85, Figures 1 to 3, of US 5,529,667) (note also the comments in col. 3, indicated lines 61 to 65, col. 8, indicated lines 36 to 52, and col. 11, indicated lines 4 to 5, of US 5,529,667).

As addressed in the foregoing, the only meaningful combination of the process disclosed by **Delannoy et al.** on the one hand, and an extractive distillation as disclosed by **Gilman et al.** and by **Coffey** on the other hand, cannot provide for a reduction of the ethylene oxide content in the bottom fraction. If a further reduction of the ethylene oxide content in the bottom fraction is desired, the temperature/pressure conditions of the bottom fraction have to correspond

to the conditions used in the extractive distillation process addressed by *Gilman et al.* and/or *Coffey*, at which point the teaching of *Delannoy et al.* no longer applies.

Again, a modification of the teaching of *Delannoy et al.* in view of the disclosure of *Gilman et al.* and/or *Coffey*, or the combination of the teaching of *Delannoy et al.* with the disclosure of *Gilman et al.* and/or *Coffey*, destroys the principles underlying the process disclosed by *Delannoy et al.* Under the Court's holding in *In re Ratti* (*ibid.*) the teachings of the references applied by the Examiner are therefore insufficient to render applicants' invention *prima facie* obvious.

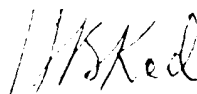
REQUEST FOR EXTENSION OF TIME:

It is respectfully requested that a one month extension of time be granted in this case. A check for the \$110.00 fee is attached.

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees to Deposit Account No. 11.0345. Please credit any excess fees to such deposit account.

Respectfully submitted,

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Encl.: THE CHANGES IN CLAIMS 1 AND 9 (Appendix I)

THE AMENDED CLAIMS 1 AND 9 (Appendix II)

Hawley's "Condensed Chemical Dictionary", pp. 5, 490, 526, 536 and 537

HBK/BAS

A P P E N D I X I:

THE CHANGES IN CLAIM 1 AND 9:

Amend Claim 1 as indicated in the following:

1. (twice amended) A process for purification of ethylene oxide by distillation, comprising the step in which
 - an aqueous mixture comprising ethylene oxide, formaldehyde and at least 5% by weight of water is introduced via a feed into a distillation apparatus comprising at least one distillation column, the mixture being introduced at a height above the bottom of at least 8 theoretical stages,
 - pure ethylene oxide containing 4 ppm or less formaldehyde, is taken off at the top and
 - in the bottom phase, a mixture is obtained which contains less than 5% by weight of ethylene oxide, ~~and~~and wherein the distillation apparatus has a side take-off between the feed and the bottom, and a mixture which is richer with acetaldehyde than the influent aqueous mixture is taken off via said side take-off.

Cancel Claim 8. Amend Claim 9 as indicated in the following:

9. (twice amended) A process as claimed in claim 1, wherein the distillation apparatus is used in which an intermediate reboiler is situated between the feed and the bottom.

A P P E N D I X II:

THE AMENDED CLAIMS 1 AND 9:

1. (twice amended) A process for purification of ethylene oxide by distillation, comprising the step in which
 - an aqueous mixture comprising ethylene oxide, formaldehyde and at least 5% by weight of water is introduced via a feed into a distillation apparatus comprising at least one distillation column, the mixture being introduced at a height above the bottom of at least 8 theoretical stages,
 - pure ethylene oxide containing 4 ppm or less formaldehyde, is taken off at the top and
 - in the bottom phase, a mixture is obtained which contains less than 5% by weight of ethylene oxide,and wherein the distillation apparatus has a side take-off between the feed and the bottom, and a mixture which is richer with acetaldehyde than the influent aqueous mixture is taken off via said side take-off.
9. (twice amended) A process as claimed in claim 1, wherein the distillation apparatus is used in which an intermediate reboiler is situated between the feed and the bottom.